Chapter 7. San Joaquin River Hydrologic Region

Setting

The San Joaquin River Hydrologic Region is located in the heart of California and includes the northern portion of the San Joaquin Valley. It is bordered on the east by the Sierra Nevada and on the west by the coastal mountains of the Diablo Range. It extends from the southern boundaries of the Sacramento – San Joaquin Delta south to include all of the San Joaquin River drainage area to the northern edge of the San Joaquin River in Madera. Roughly half of the Sacramento – San Joaquin Delta region lies within this hydrologic region, encompassing those portions of the Delta within Contra Costa, Alameda, and San Joaquin Counties. The Region extends south from just below the northeastern corner of Sacramento County and eastward to include the southern third of El Dorado County, almost all of Amador County, all of Calaveras and Tuolumne Counties, and the western slope of Alpine County. The San Joaquin River Basin is hydrologically separated from the Tulare Lake Basin by a low, broad ridge across the trough of the San Joaquin Valley between the San Joaquin and Kings Rivers. A map and table of statistics describing the region are presented on page 3.

While one of the state's longest rivers at 300 miles, the San Joaquin River's average unimpaired runoff is approximately 1.8 million acre-feet per year. The San Joaquin River and its eight major tributaries drain about 32,000 square miles. The headwaters of the San Joaquin River begin nearly 14,000 feet above sea level at the crest of the Sierra Nevada. The river runs west down the mountains and foothills, and then flows northwest to the Delta where it meets the Sacramento River. The two rivers converge in the 1,153-square-mile Sacramento-San Joaquin Delta—a maze of channels and islands—which also receives fresh water inflow from the Cosumnes, Mokelumne and Calaveras rivers and other smaller streams. Historically, more than 40 percent of the state's run-off flowed to the Delta via the Sacramento, San Joaquin and Mokelumne rivers.

Climate

Because the San Joaquin Valley is isolated by mountains from the marine effects of coastal California, the average maximum summer temperature in the valley advances to a high of 101 degrees during the latter part of July. The daily maximum temperature during this warmest month has ranged from 76 to 115 degrees. The northern part of this hydrologic region does benefit from “Delta breezes” during the hotter summer periods, typically as consistent winds driven by the strong temperature difference between hot Valley temperatures and cooler marine temperatures in the San Francisco Bay Area. Winter temperatures in the valley floor regions are usually mild but during infrequent cold spells minimum readings occasionally drop below freezing. Heavy frost occurs in most winters, typically between the end of November and early March.

The San Joaquin Valley experiences a range of climate and precipitation, which varies from lesser amounts on the valley floor to medium rainfall amounts in the foothills, and to extensive amounts of snow in the higher ranges of the Sierra Nevada mountains. The climate of much of the upland area west of the valley resembles that of the Sierra foothills. The average annual precipitation of several Sierra Nevada stations is about 35 inches. Snowmelt runoff from the mountainous areas is the major contributor to local water supplies for the eastern San Joaquin Valley floor. The climate of the valley floor is characterized by long, hot summers and mild winters, and average annual precipitation ranges from about 22.5 inches near the Sacramento area in the northeast to about 6.5 inches near the drier southwestern corner of the Region.

Population

The population of the San Joaquin River Region in year 2000 was about 1.7 million, which is about 5 percent of the State's total population. Although there are fifteen counties partially or entirely within the San Joaquin River Region, the majority of the population and land use occurs within 4 counties: San Joaquin, Stanislaus, Merced, and Madera. Of these, the county with the largest population is San Joaquin County (567,800); and it’s largest city is Stockton with 243,770 inhabitants. The City of Modesto, located in Stanislaus County (the second largest county at 449,800) has a population of 188,860. The largest city in Merced County (total population of 210,900) is the county seat in Merced with a population of 63,890. Finally, the City of Madera in Madera County (124,400) has a population of 43,210.

California experienced a population increase approaching 15 percent from 1990 to 2000, and the growth rates in San Joaquin valley cities and counties are following this trend. According to California Department of Finance projections, growth rates for the above four counties will range between 21 and 31 percent over the next ten years, with the highest urbanization occurring in the northern portion of this region. For San Joaquin County, projected populations will increase to 747,000 by year 2010 and to 1,229,000 by year 2030. Similarly, the projected population for Stanislaus County will increase to 559,000 by year 2010, and to 744,000 by year 2030. The ongoing rapid rate of urbanization in these regions will generate significant land and water uses challenges for the entire San Joaquin Valley.

Land Use

The valley portion of the San Joaquin region consists primarily of highly productive farmland and rapidly growing urban areas of Stockton, Tracy, Modesto, Manteca, and Merced. Agriculture is the major economic and land use activity in the San Joaquin River Region. The San Joaquin Valley ranks among the most important agricultural regions in California, with roughly 2 million acres of irrigated cropland and an annual output valued at more than $ 4.9 billion. Irrigated acreage is very diversified with about 37 percent planted to permanent crops and 28 percent to grains, hay and pasture. Some of the other major crops include cotton, corn, tomatoes, and other field and truck crops. In addition to agriculture, other important industries in the region include food processing, chemical production, lumber and wood products, glass, textiles, paper, machinery, fabricated metal products and various other commodities.

While the San Joaquin Valley is predominantly privately owned agricultural land, much of the Sierra Nevada Mountains is national forest land. These mountain regions on the east side of the valley include the El Dorado, Stanislaus, and Sierra National Forests and the Yosemite National Park. Public lands amount to about one-third of the region. The national forest and park lands encompass over 2,900,000 acres; state parks and recreational areas and other State-owned property account for about 80,000 acres; and BLM and military properties occupy over 200,000 and 5,100 acres, respectively. The valley portion of the region constitutes about 3,500,000 acres, the eastern foothills and mountains total about 5,800,000 acres, and the western coastal mountains comprise about 900,000 acres. About 1,840,000 (19 percent) of the region's 9,737,200 acres were devoted to irrigated agriculture in 2000.

The restoration of Central Valley wetlands habitat is critical to the preservation of many species of fish and wildlife in the San Joaquin River ecosystem. Beginning in the 1990’s agencies and programs began to make progress in efforts to set aside and restore acreage for wetland habitat. In 1990 the San Joaquin River Management Program was formed to identify and plan programs and projects to restore the river system, which led to completion of the San Joaquin River Management Plan (SJRMP) in 1995. This plan identified nearly 80 consensus-based actions intended to benefit the San Joaquin River system, which are organized into the categories of projects, feasibility studies and riparian habitat acquisitions. Many federal and state agencies now have active roles in the funding and implementation of wetlands habitat restoration programs, including the US Fish & Wild Service, the California Bay-Delta Authority and the California Department of Fish & Game. One of the larger current projects along the San Joaquin River is the restoration of 775 acres of native riparian habitat on the West Unit of the San Joaquin River National Wildlife Refuge, located west of Modesto. Approximately 158,000 native trees, shrubs and vines will be planted to accommodate the habitat needs of threatened and endangered species.

The San Joaquin Valley serves as a breeding and resting ground along the Pacific Flyway for many species of waterfowl. Public wildlife refuges in the San Joaquin River Region that support this habitat need include the San Luis National Wildlife Refuge (26,340 acres), San Joaquin River National Wildlife Refuge (2,875 acres), Merced National Wildlife Refuge (8,280 acres), Los Banos Wildlife Area (5,310 acres), Volta Wildlife Area (2,180 acres), the North Grasslands Wildlife Area (2,160 acres), the White Slough Wildlife Area (969 acres), and the Isenberg Sandhill Crane Reserve (361 acres). Towards the northern end of this region, the Cosumnes River Preserve is managed by the Nature Conservancy and has now become the largest refuge area in the region (36,300 acres).

Water Supply and Use

The primary sources of surface water in the San Joaquin River Basin are the rivers that drain the western slope of the Sierra Nevada Mountains. These include the San Joaquin River and its major tributaries, the Merced, Tuolumne, Stanislaus, Calaveras, Mokelumne, and Cosumnes rivers. Most of these rivers drain large areas of high elevation watershed that supply snowmelt runoff during the late spring and early summer months. Other tributaries to the San Joaquin River, including the Chowchilla and Fresno rivers, originate in the Sierra Nevada foothills, where most of the runoff results from rainfall.

In 2000, an average year, about 43 percent of the San Joaquin region's developed water supply came from local surface sources, 24 percent was from imported surface supplies, and groundwater provided about 33 percent of the water supply. About 30 percent of the developed supply (excluding surface and groundwater reuse) was considered dedicated natural flows for meeting instream flow requirements.

Surface water supply systems in the Sierra streams and rivers form a general pattern. A series of small reservoirs in the mountain valleys gathers and stores snowmelt. This water is used to generate electricity as it is released downstream. Some diversions occur for consumptive use in local communities, but most flows are recaptured in larger reservoirs located in the foothills and along the eastern edge of the valley floor. Most of these reservoirs were built primarily for flood control; however, many of them also have additional storage capacity for water supply and other uses included in their design. Irrigation canals and municipal pipelines divert much of the water from or below these reservoirs. Most of the small communities in the Sierra foothills receive much of their water from local surface supplies. The extensive network of canals and ditches constructed in the 1850s for hydraulic mining forms the basis of many of the conveyance systems. In addition to surface water, many of these mountain communities pump groundwater from hard rock wells and old mines to augment their supplies, especially during droughts. Groundwater is the only source for many mountain residents who are not connected to a conveyance system.

On the valley floor, many agricultural and municipal users receive their water supply from large irrigation districts, including Modesto Irrigation District, Merced, Oakdale, South San Joaquin and Turlock Irrigation Districts. Most of this region's imported supplies, about 1.9 million acre-feet per year, are delivered by the federal Central Valley Project. Oak Flat Water District receives about 4,500 acre-feet per year from the State Water Project.

Most of the water in the upper San Joaquin River is diverted at Friant Dam, and is conveyed north through the Madera Canal and south through the Friant-Kern Canal. Average annual diversions from the San Joaquin River through the Friant-Kern and Madera Canals is about 1,500,000 acre-feet. Releases from Friant Dam to the San Joaquin River are generally limited to those required to satisfy downstream water rights (above Gravelly Ford) and for flood control. In the vicinity of Gravelly Ford, high channel losses to the ground water basin occur because the river bed is primarily sand and gravel. Due to the operation of Friant Dam, there are seldom any surface flows in the lower San Joaquin River except for flows originating in the major downstream tributaries plus agricultural and municipal return flows.

The San Joaquin River tributaries provide the San Joaquin River Basin with high-quality water and most of its surface water supplies. Most of this water is regulated by reservoirs and used on the east side of the valley, but some is diverted across the valley to the Bay Area via the Mokelumne Aqueduct, which supplies some for the urban water needs of East Bay MUD, and the Hetch Hetchy Aqueduct, which supplies urban water to the City of San Francisco and several other bay areas cities. Average annual diversion from the Mokelumne and Tuolumne rivers that are directly exported from the basin include 245,000 acre-feet through the Mokelumne Aqueduct and 267,000 acre-feet through the Hetch-Hetchy Aqueduct. Major dams on the tributary streams include Pardee and Camanche dams on the Mokelumne River, New Melones, Donnells, and Beardsley dams on the Stanislaus River, O'Shaunessy and New Don Pedro dams on the Tuolumne River, and Exchequer Dam on the Merced River.

In 2000, an average water year, agriculture accounted for 57 percent of the region's total developed water use, while urban water use was about 5 percent and environmental water use for dedicated purposes was 38 percent of the total. Regional average per capita water use was about 278 gpcd. Imported supplies, including CVP, SWP, and other federal deliveries, amounted to 1,902,300 af. Environmental demands (refuges, instream requirements, and wild and scenic flow requirements) totaled 4,634,000 af.

The following water balance table for the San Joaquin hydrologic region summarizes the detailed regional water accounting contained in the water portfolio at the end of this regional description. As shown in the table, changes in groundwater storage are balanced with the available surface water each year to meet the regions needs. In wet years like 1998, excess water supply is added into ground water storage, while in dry years (like 2001) the amount of ground water pumped to meet water needs results in a net loss of ground water storage.

State of the Region

Challenges

Historically, the surface water originating from Sierra Nevada rivers has proven to be a dependable supply of high quality water, but it meets only about half of the region's total water requirement. Imported surface water and groundwater make up the difference. Due to the reliance on imported surface water from other regions, there is growing concern over the long-term availability of these supplies.

Additionally, proposals to restore fisheries on the San Joaquin River through higher releases of water from Friant Dam have resulted in growing concerns over the long-term availability of the Sierra water supplies.

One of the major challenges facing the region is how to accomplish ecosystem restoration, especially along the San Joaquin River below Friant Dam, since the river receives no significant inflow until its confluence with the Merced River. The river's salmon population upstream of the Merced River, which once was very large, has all but disappeared. Restoring some flow to the San Joaquin River should enhance ecosystem restoration opportunities, but could significantly impact the water supplies for members of the Friant Water Users Authority, as well as have economic impacts on the thousands of farmers, communities, public agencies, related businesses, employees and consumers who depend on the water from Friant Dam.

Groundwater pumping, a major source of supply in the region, continues to increase in response to growing urban and agricultural demands. Over the long-term, groundwater extraction cannot continue to be utilized to satisfy the portion of water demands that are not met by surface water supplies, without producing negative groundwater basin impacts. One such impact is groundwater overdraft, a condition wherein the average long term amount of water withdrawn by pumping exceeds the amount of water that recharges the basin. A serious effect of long-term groundwater overdraft is land subsidence, which results in a loss of aquifer storage space and may cause damage to public facilities such as canals, utilities, pipelines, and roads. To help battle potential serious “overdraft” conditions in some areas of the region, groundwater replenishment is being provided through planned recharge programs, the over-irrigation of crops with extra surface water in wet years, incidental deep percolation, and seepage from unlined canal systems.

In general, groundwater quality throughout the region is suitable for most urban and agricultural uses. Nevertheless, groundwater with high TDS content can be found along the western edge of the valley floor, where the high-saline marine sediments of the Coast Range exist. In addition, the salinity of groundwater in the region increases when the evapotranspiration of crops leaves behind the majority of the salt contained in the applied water. Another water quality concern is nitrates in the region’s groundwater. Nitrates may occur naturally, from the disposal of human and animal waste products, or from the application of fertilizer. Agricultural pesticides and herbicides have also been detected in groundwater samples from the region. The most notable agricultural contaminant detected in samples from the region is dibromochloropropane (DBCP). Industrial organic contaminants detected in samples from the region include TCE, dichloroethylene (DCE), and other solvents, which were found in groundwater samples taken near airports, industrial areas, and landfills.

The major surface water quality problems of San Joaquin Valley streams are a result of significant salt loads from agricultural and wetland drainage and runoff, as well as from the degraded water quality of municipal and industrial wastewater discharges. High salinity is a problem in the lower San Joaquin River, principally under low flow conditions, when there is not enough flow to dilute agricultural return flows into the river. Additionally, high water table conditions along the western side of the San Joaquin River Basin promote subsurface drainage problems. This high water table condition is managed by collecting the drainage water via earthen canals and/or tile drains, conveying it away from the area to storage ponds, reusing it, or allowing it to flow into the San Joaquin River.

Accomplishments

The Reclamation Board of the State of California and the U.S. Army Corps of Engineers (Corps), in coordination with a broad array of stakeholders, have developed a Comprehensive Plan for the flood management system of the Sacramento and San Joaquin River basins. Rather than a physical plan, the Comprehensive Plan constitutes an approach to developing projects in the future to reduce damages from flooding and restore the ecosystem.

The Millerton Area Watershed Coalition will conduct a comprehensive assessment of the San Joaquin River watershed and assess how and what activities need to be changed to better protect and care for the watershed. The information learned will be developed into an outreach activity to promote the protection and enhancement of the watershed including the economic and environmental well being of the communities within it, as well as of the downstream users. This is a CalFed Watershed Program through the U.S. Bureau of Reclamation.

The San Joaquin River Group Authority (SJRGA) was formed in the 1990's in response to the development of the Sacramento – San Joaquin Bay Delta Water Quality Control Plan by the SWRCB. The WQCP was adopted in 1995 and included significant water quality and flow standards for the lower San Joaquin River. The goals of the SJRGA are to investigate fishery and water quality issues on the San Joaquin River, and develop solutions that will protect the salmon fishery and improve water quality. To respond to water quality issues, the Regional Water Quality Control Board is studying agricultural discharge quality controls, and may consider the use of agriculture waivers at a watershed level. Additional water quality monitoring will be necessary to address the various water quality problems on the Lower San Joaquin River. Landowners will have the choice of participating in water quality monitoring and improvement programs on a watershed level or on an individual basis. The watershed approach can be used to identify and address "hot spots" by working directly with individual landowners or encouraging individuals to work together to find solutions.

The SJRGA also led the development of the Vernalis Adaptive Management Plan (VAMP) as a ten year test program designed to study methods to improve salmon smolt survival in the lower San Joaquin River. Starting in year 2000, VAMP has coordinated the release of water from upstream reservoirs each spring to generate a calculated pulse flow down the lower river to help salmon smolts migrate to San Francisco Bay and the ocean. The timing and duration of this pulse flow is coordinated with reduced SWP and CVP Delta export pumping in order to improve Delta flow patterns that will guide the salmon smolts to the ocean. VAMP's technical group coordinates extensively with several local and government agencies to oversee the successful test flow each year, which include real-time facility operations and monitoring, tracking of water flows and fish migration, and outreach and education. It is still too early in the ten year test period to determine how successful this program will be in meeting its objectives.

The Upper San Joaquin River Basin Storage Investigation evolved out of the Cal-fed Record of Decision. The ROD states that "250,000 to 750,000 acre-feet of additional storage in the upper San Joaquin watershed…would be designed to contribute to restoration of and improve water quality for the San Joaquin River and facilitate conjunctive water management and water exchanges that improve the quality of water deliveries to urban communities. Additional storage could come from enlargement of Millerton Lake at Friant Dam or a functionally equivalent storage program in the region." Surface storage options within the San Joaquin River region that may be considered after completion of the CALFED Phase I process include of the investigation of (1) raising Friant Dam, (2) Fine Gold Creek Dam, and (3)

Temperance Flat Dam (3 sites). Additionally, Yokohl Valley Reservoir near Visalia in the Tulare Lake Region is also under consideration.

The cities of Tracy, Manteca, Lathrup and Escalon, in partnership with the South San Joaquin Irrigation District are planning to construct a water treatment plant on the Stanislaus River. The South San Joaquin County Surface Water Supply Project will use water that the SSJID has conserved from its efficient irrigation practices. Water will be taken from Woodward Reservoir, treated to drinking standards and conveyed to the cities. A 40-mile long transmission pipeline would also be constructed from the treatment plant to deliver water to each of the participant cities. The $150 million project is expected to begin deliveries around May 2005. The project is scheduled at that point to deliver 30,000 af/yr to the cities through 2010 and up to 44,000 af/yr thereafter. The intent of the project is to reduce the reliance on groundwater and to provide for future increases in urban demands.

Relationship with Other Regions

The San Joaquin River Region is dependent on receiving surface water from other regions of the State to meet a portion of the developed agricultural and urban water uses. For many years the region has received imported CVP water from the Sacramento-San Joaquin Delta via the Delta Mendota Canal and from the CVP's Friant Dam, which also diverts Sierra water supplies to the Tulare Lake region. The San Joaquin region also receives some SWP water from the California Aqueduct.

Some surface supplies that original in the San Joaquin region are also diverted across the valley to the Bay Area (San Francisco Bay Region) via the Mokelumne Aqueduct (by East Bay Municipal Utility District) and the Hetch Hetchy Aqueduct (by City & County of San Francisco). The average annual diversions by these two projects from the Mokelumne and Tuolumne rivers are currently about 245,000 acre-feet/year through the Mokelumne Aqueduct and 267,000 acre-feet/year through the Hetch-Hetchy Aqueduct.

Contra Costa Water District recently completed Los Vaqueros Reservoir in 1998, which can hold 100,000 af, is an off-stream reservoir located in the northwest corner of the San Joaquin hydrologic region. This reservoir holds CCWD water that has been diverted water from the Delta in the late winter and spring months. Water is typically withdrawn from Los Vaqueros Reservoir to meet summer demands in the CCWD service area. However, since the CCWD service area is in the San Francisco Bay hydrologic region, this water is considered to be an export from the San Joaquin region. As a new reservoir, Los Vaqueros has only been operated for a few years, such that normal patterns of diversion and water use have not yet been established.

Looking to the Future

The region's water agencies have many ongoing projects and programs to address water supply problems. These include investigations for new local surface storage projects and investigations for storage development in conjunction with CALFED. Local agencies are further implementing conjunctive use projects and increasing their efforts on water use efficiency and water recycling programs. As the urban cities on the valley floor continue to grow and expand, the current trend of agricultural land conversion to subdivisions is likely to continue. As an outcome of urban expansion, urban water usage is expected to increase in the future, while agricultural water use is projected to decline slightly. The effectiveness of current and planned urban and agricultural water conservation and use efficiency measures will influence these water use trends.

Regional Planning

The San Joaquin Valley Water Coalition is a forum where all the interests in the Valley can come together to discuss common issues related to water supply, quality, and distribution to ensure a water supply for the Valley that is sustainable and meets the needs and concerns of all water users. The Westside Integrated Water Resources Plan, initiated in 2000, is evaluating supply increases and demand reductions to correct the water supply deficits caused by the CVPIA. The West Stanislaus Hydrologic Unit Area Project is a USDA and local grower effort to enhance water quality by reducing soil erosion into the San Joaquin River.

Many other programs are focusing on ecosystem restoration on the Merced, Stanislaus, Tuolumne, and San Joaquin Rivers. The Grassland Bypass Project on the Westside of the valley will consolidate the conveyance of subsurface drainflows on a regional basis and utilize a portion of the federal San Luis Drain to convey drainflows around the Grassland habitat areas into Mud Slough before being discharged into the San Joaquin River above its confluence with the Merced River. The San Joaquin River Parkway and Conservation Trust‘s goals are to preserve and restore San Joaquin River lands having ecological, scenic or historic significance, educate the public on the need for stewardship, research issues affecting the river, and promote educational, recreational and agricultural uses consistent with the protection of the river’s resources.

Work is continuing on several programs at the watershed level in the region. For example, the San Joaquin River Management Program is seeking solutions to the common problems facing the region that affect the environment, water quality, agriculture, flood control, etc. within the San Joaquin River watershed, without the limitations imposed by political boundaries. Also, several public/private partnerships on the eastside of the valley are attempting to develop a Comprehensive Plan for the Management, Protection and Restoration of Watersheds of the San Joaquin, Merced, Chowchilla, and Fresno Rivers and to attain designation as a Resource Conservation & Development (RC&D) Area, so watershed projects can be coordinated in Mariposa County and eastern Madera County.

Water Portfolios for Water Years 1998, 2000, and 2001

Water Year 1998

California experienced another El Nino year (July 1997-June 1998) in 1998. The previous El Nino year was in 1991-1992. Precipitation records were broken all over the state, as spring in the Central Valley emerged. Precipitation in Fresno exceeded 180 percent of average, Stockton was almost 200 percent of average, and Los Banos was 248 percent of average. Watershed runoff was well above average, as streamflow in the San Joaquin, Merced, Stanislaus and Tuolumne Rivers was about 165 percent of average.

Total irrigated acreage was about 2,053,600 acres. Alfalfa acreage accounted for 11.5 percent of all irrigated acreage in the San Joaquin region; almonds/ pistachios acreage accounted for 13.8 percent; and vineyard acreage, 10.9 percent. Compared to 1995 acreage, irrigated pasture acreage was down to 15,400 acres; however, acreage was up for corn (36,800), almonds/pistachios (8,600), and vineyards (29,600). Thus, growers continued the trend of converting field cropland to almond/pistachio orchards and vineyards in an effort to find a commodity that would provide better long-term profits.

The El Nino phenomenon had such an impact on the San Joaquin region's volume of precipitation that growers in most cases had little need to irrigate during the first 4 to 5 months of 1998. The total 1998 agricultural applied water was 5.5 maf (47 percent of all uses). The regional average agricultural AW was 2.4 af/ac. Crop evapotranspiration of applied water is also known as the crop water requirement that must be met with irrigation. The total agricultural ETAW in 1998 amounted to 3.4 maf. The regional average ETAW was 1.7af/ac.

Total urban applied water (including residential, commercial, industrial, and landscape) in the region totaled over 515,900 acre-feet. The average per capita water use was about 265 gallons per day, and the urban ETAW was 187,600 acre-feet. Urban applied water accounted for about 4 percent of the total water use in the region. Population for the region was 1,636,210, 2.8 percent more than 1995.

Total environmental demand (instream, wild and scenic, and refuges) for the region was about 5.6 maf acre-feet. This accounts for 47 percent of total uses. This includes water that is reserved for instream and wild and scenic river flow, but that can be later used as a supply by downstream users. Refuge supplies, which are supplies applied directly onto wildlife refuges, accounts for 411,400 af or 4 percent of total uses.

Total supplies, including local and imported (CVP & SWP) surface water, groundwater, and reuse, amounted to 11.7 maf.

Water Year 2000

The weather of water year 1999-2000 in the San Joaquin River Region produced average precipitation and streamflow. Rainfall amounts were slightly above average for most of the measuring stations within the region; precipitation as a percent of average in Madera and Modesto was 120 percent, Stockton 99 percent, and Los Banos 88 percent. Ample moisture was received in the local watersheds, and runoff resulted in good water supplies. Watershed runoff was about average, with unimpaired runoff from the Tuolumne, Merced and San Joaquin rivers at about 103 percent of average. However, the Stanislaus, Mokelumne, and Cosumnes rivers were 99, 89, and 70 percent, respectively. Heavy rainfall occurred in January and February delaying many field activities such as pruning, planting, spraying, and field preparation.

Total irrigated acreage decreased only slightly from 1998 to 2000, reaching 2,050,400 acres. The 2000 almond/pistachio acreage of 292,500 acres was 9,300 acres higher than the acreage in 1998. The acreage of sugar beets dropped 26 percent to 18,500 acres. The acreages of most the remaining crops changed little from 1998.

In general, 2000 weather, water supplies, and evaporative demand were close to average in the San Joaquin region. The total agricultural applied water in 2000 was 7.0 maf (57 percent of all uses), about 27 percent more than 1998. The regional average AW was 3.0 af/ac. The total agricultural ETAW was about 4.4 maf, 29 percent higher than 1998. The regional average ETAW was 2.1 af/ac.

Total urban applied water for the region was 565,800 acre-feet, which was about 10 percent higher than the total urban applied water for 1998. Average per capita water use was around 278 gallons per day, and total urban ETAW for the year was about 211,200 acre-feet. Urban applied water accounted for about 5 percent of the total water use in the region. Population for the region was 1,716,680, 4.9 percent more than 1998.

Total environmental demand (instream, wild and scenic, and refuges) for the region was about 4.6 maf. This accounts for 38 percent of total uses. This includes water that is reserved for instream and wild & scenic river flow, but that can be later used as a supply by downstream users. Refuge supplies, which are supplies applied directly onto wildlife refuges, accounts for 441,600 af or 4 percent of total uses.

Total supplies, including local and imported (CVP and SWP) surface water, groundwater, and reuse, amounted to 12.2 maf.

Water Year 2001

The 2000-2001 water year started out cooler than normal with cumulative rainfall below average through most of January. Rainfall amounts were slightly less than average for the water year with annual totals of 88 and 83 percent of average in Madera and Stockton, respectively. As the accumulated precipitation lagged in January, large scale weather patterns changed significantly as February approached and a series of Pacific storms moved into the state, helping to bring precipitation totals closer to average. This cool wet period delayed many cultural activities such as pruning, planting, spraying, and ground preparation. A thunderstorm on April 7 brought wind, hail, and heavy rain that damaged grapevines, cotton, grains, and vegetables in Madera and Merced counties; cotton fields damaged by the storm were replanted. The weather became warmer by late April and through the remainder of the growing season offered good growing conditions.

Irrigated crop acreage decreased 7,700 acres from 2000 to a total of 2,042,700. Irrigated pasture acreage declined 28,900 acres (15.4 percent) from 1998; 1998 sugar beet acreage decreased to 7,600 acres, a 70 percent decline. However, miscellaneous truck acreage increased 10,800 acres (16.7 percent) over 1998, and vineyard acreage increased 18,800 acres (8.4 percent), while almond/pistachios have increased in acreage by 13,000 acres since 1998.

The total agricultural applied water for 2001 was 7.1 maf (67 percent of all water uses), 33 percent more than 1998 and 5 percent more than 2000. The regional average AW was 3.2 af/ac. The total agricultural ETAW was estimated to be 4.6 maf. This was about 36 percent higher than 1998 and 5 percent higher than 2000. The regional average ETAW was 2.3 af/ac.

Total urban applied water for the region was 593,800 af, which was 15 percent higher than 1998 and 5 percent higher than 2000. Average per capita water use was about 283 gallons per day, and total urban ETAW was about 219,900 acre-feet. Urban applied water accounted for about 5 percent of the total water use in the region. Population for the region was 1,778,030, 8.7 percent more than 1998.

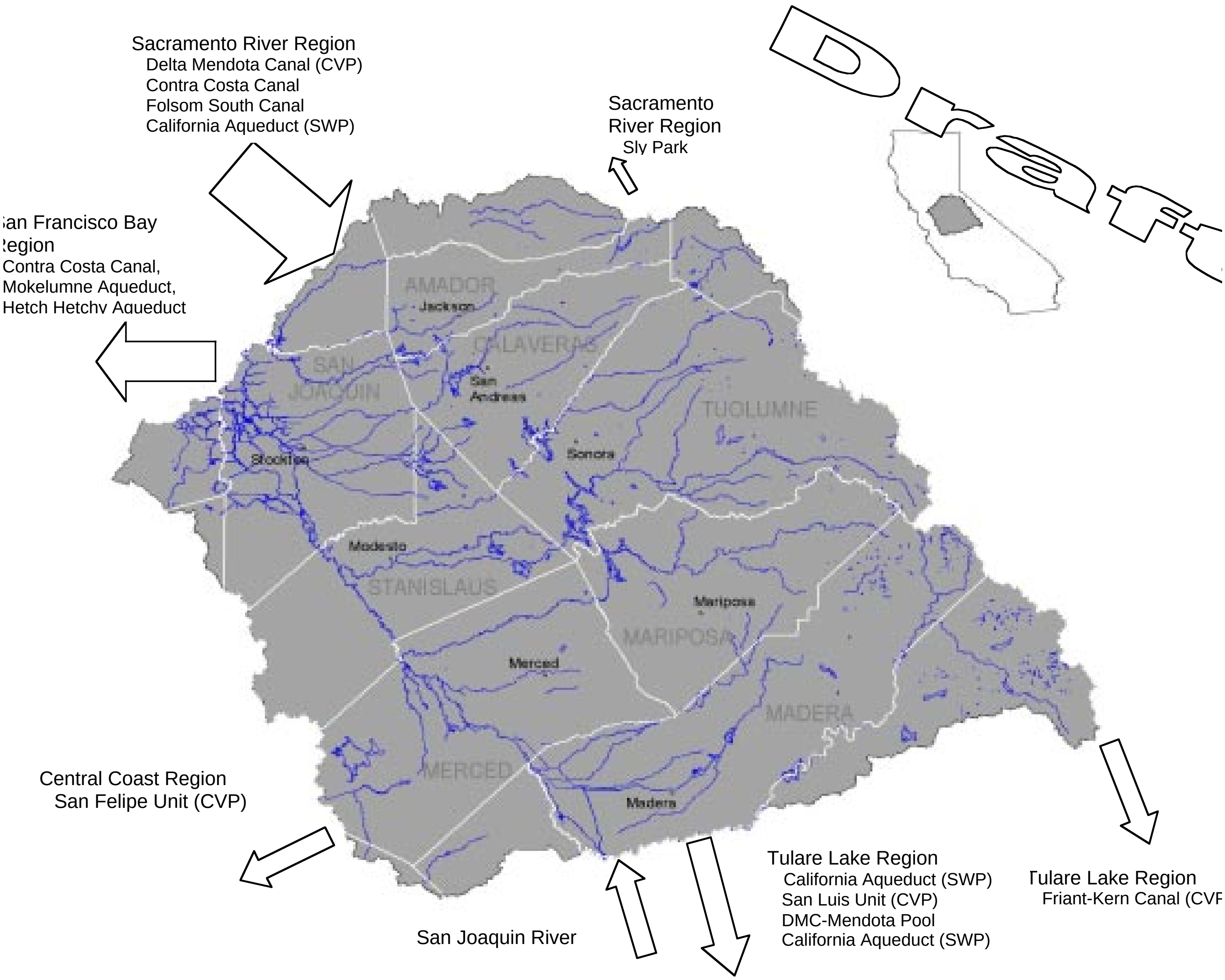
Total environmental demand (instream, wild & scenic, and refuges) for the region was about 2.9 maf. This accounts for 27 percent of total uses. This includes water that is reserved for instream and wild & scenic river flow, but that can be later used as a supply by downstream users. Refuge supplies, which are supplies applied directly onto wildlife refuges, accounts for 411,700 af or 4 percent of total uses.

Total supplies, including local and imported (CVP and SWP) surface water, groundwater, and reuse, amounted to 10.8 maf.

Sources of Information

- Water Quality Control Plan, Regional Water Quality Control Board
- Watershed Management Initiative Chapter, Regional Water Quality Control Board
- 2002 California 305(b) Report on Water Quality, State Water Resources Control Board
- Bulletin 118 (Draft), California’s Groundwater, Update 2003, Department of Water Resources
- Strategic Plan, State Water Resources Control Board, Regional Water Quality Control Boards, November 15, 2001
- U.S. Bureau of Reclamation
- San Joaquin River Management Program Advisory Council
- The Modesto Bee
- Contra Costa Water District

Figure 7-1
San Joaquin River Hydrologic Region
(Revised May 25, 2004)



Some Statistics

- Area - 15,214 square miles (9.6 percent of State)
- Average annual precipitation – 26.3 inches
- Year 2000 population - 1,751,005
- 2030 projected population –
- Total reservoir storage capacity - 11,477 TAF

Table 7-1
San Joaquin River Hydrologic Region Water Balance Summary – TAF

Water Entering the Region – Water Leaving the Region = Storage Changes in Region

	1998 (wet)	2000 (average)	2001 (dry)
Water Entering the Region			
Precipitation	35,535	23,209	16,120
Inflow from Oregon/Mexico	0	0	0
Inflow from Colorado River	0	0	0
Imports from Other Regions	5,192	5,288	3,890
Total	**40,727**	**28,497**	**20,010**
Water Leaving the Region			
Consumptive Use of Applied Water * (Ag, M&I, Wetlands)	3,702	4,765	4,983
Outflow to Oregon/Nevada/Mexico	0	0	0
Exports to Other Regions	4,013	5,848	4,073
Statutory Required Outflow to Salt Sink	0	0	0
Additional Outflow to Salt Sink	146	402	513
Evaporation, Evapotranspiration of Native Vegetation, Groundwater Subsurface Outflows, Natural and Incidental Runoff, Ag Effective Precipitation & Other Outflows	31,129	17,512	13,208
Total	**38,990**	**28,527**	**22,777**
Storage Changes in the Region [+] Water added to storage [–] Water removed from storage			
Change in Surface Reservoir Storage	2,180	67	-1,435
Change in Groundwater Storage **	-443	-97	-1,332
Total	**1,737**	**-30**	**-2,767**

Applied Water * (compare with Consumptive Use) * Definition - Consumptive use is the amount of applied water used and no longer available as a source of supply. Applied water is greater than consumptive use because it includes consumptive use, reuse, and outflows.	6,064	7,524	7,676

**Footnote for change in Groundwater Storage

Change in Groundwater Storage is based upon best available information. Basins in the north part of the State (North Coast, San Francisco, Sacramento River and North Lahontan Regions and parts of Central Coast and San Joaquin River Regions) have been modeled – spring 1997 to spring 1998 for the 1998 water year and spring 1999 to spring 2000 for the 2000 water year. All other regions and year 2001 were calculated using the following equation:

GW change in storage =

intentional recharge + deep percolation of applied water + conveyance deep percolation - withdrawals

This equation does not include the unknown factors such as natural recharge and subsurface inflow and outflow.

Table 7-2
Water Portfolios for Water Years 1998, 2000 and 2001

Category	Description	San Joaquin River 1998 (TAF)				San Joaquin River 2000 (TAF)				San Joaquin River 2001 (TAF)				
		Water Portfolio	Applied Water	Net Water	Depletion	Water Portfolio	Applied Water	Net Water	Depletion	Water Portfolio	Applied Water	Net Water	Depletion	Data Detail
Inputs:														
1	Colorado River Deliveries		-				-				-			PSA/DAU
2	Total Desalination		-				-				-			PSA/DAU
3	Water from Refineries		-				-				-			PSA/DAU
4a	Inflow From Oregon		-				-				-			PSA/DAU
b	Inflow From Mexico		-				-				-			PSA/DAU
5	Precipitation	35,534.7				23,208.5				16,120.2				REGION
6a	Runoff - Natural	N/A				N/A				N/A				REGION
b	Runoff - Incidental	N/A				N/A				N/A				REGION
7	Total Groundwater Natural Recharge	N/A				N/A				N/A				REGION
8	Groundwater Subsurface Inflow	-				-				-				REGION
9	Local Deliveries		3,264.7				3,455.4				3,381.8			PSA/DAU
10	Local Imports		-				-				-			PSA/DAU
11a	Central Valley Project :: Base Deliveries		148.0				167.4				168.2			PSA/DAU
b	Central Valley Project :: Project Deliveries		1,248.7				1,667.0				1,545.2			PSA/DAU
12	Other Federal Deliveries		63.4				63.2				96.4			PSA/DAU
13	State Water Project Deliveries		4.3				4.7				3.5			PSA/DAU
14a	Water Transfers - Regional		-				-				-			PSA/DAU
b	Water Transfers - Imported		-				-				-			PSA/DAU
15a	Releases for Delta Outflow - CVP		-				-				-			REGION
b	Releases for Delta Outflow - SWP		-				-				-			REGION
c	Instream Flow		1,528.9				2,098.5				1,424.4			REGION
16	Environmental Water Account Releases		-				-				-			PSA/DAU
17a	Conveyance Return Flows to Developed Supply - Urban		-				-				-			PSA/DAU
b	Conveyance Return Flows to Developed Supply - Ag		-				-				-			PSA/DAU
c	Conveyance Return Flows to Developed Supply - Managed Wetla		-				-				-			PSA/DAU
18a	Conveyance Seepage - Urban		-				-				-			PSA/DAU
b	Conveyance Seepage - Ag		6.6				6.6				6.7			PSA/DAU
c	Conveyance Seepage - Managed Wetlands		-				-				-			PSA/DAU
19a	Recycled Water - Agriculture		1.2				1.2				1.2			PSA/DAU
b	Recycled Water - Urban		0.7				0.7				0.7			PSA/DAU
c	Recycled Water - Groundwater		-				-				-			PSA/DAU
20a	Return Flow to Developed Supply - Ag		1,259.0				677.1				628.2			PSA/DAU
b	Return Flow to Developed Supply - Wetlands		132.6				126.7				134.2			PSA/DAU
c	Return Flow to Developed Supply - Urban		-				-				-			PSA/DAU
21a	Deep Percolation of Applied Water - Ag		157.7				844.2				910.1			PSA/DAU
b	Deep Percolation of Applied Water - Wetlands		174.3				166.5				142.3			PSA/DAU
c	Deep Percolation of Applied Water - Urban		204.1				219.7				226.0			PSA/DAU
22a	Reuse of Return Flows within Region - Ag		-				-				-			PSA/DAU
b	Reuse of Return Flows within Region - Wetlands, Instream, W&S		5,190.0				4,192.3				2,515.4			PSA/DAU
24a	Return Flow for Delta Outflow - Ag		-				-				-			PSA/DAU
b	Return Flow for Delta Outflow - Wetlands, Instream, W&S		0.1				-				-			PSA/DAU
c	Return Flow for Delta Outflow - Urban Wastewater		-				-				-			PSA/DAU
25	Direct Diversions	N/A				N/A				N/A				PSA/DAU
26	Surface Water in Storage - Beg of Yr	6,943.0				7,378.6				7,446.0				PSA/DAU
27	Groundwater Extractions - Banked	-				-				-				PSA/DAU
28	Groundwater Extractions - Adjudicated	-				-				-				PSA/DAU
29	Groundwater Extractions - Unadjudicated	1,750.2				2,655.6				2,954.9				REGION
Withdrawals:	**In Thousand Acre-feet**													
23	Groundwater Subsurface Outflow	N/A				N/A				N/A				REGION
30	Surface Water Storage - End of Yr	9,122.9				7,446.0				6,010.8				PSA/DAU
31	Groundwater Recharge-Contract Banking		-				-				-			PSA/DAU
32	Groundwater Recharge-Adjudicated Basins		-				-				-			PSA/DAU
33	Groundwater Recharge-Unadjudicated Basins		-				-				-			REGION
34a	Evaporation and Evapotranspiration from Native Vegetation				N/A				N/A				N/A	REGION
b	Evaporation and Evapotranspiration from Unirrigated Ag				N/A				N/A				N/A	REGION
35a	Evaporation from Lakes				77.3				89.7				82.0	REGION
b	Evaporation from Reservoirs				419.9				477.1				449.3	REGION
36	Ag Effective Precipitation on Irrigated Lands		N/A				N/A				N/A			REGION
37	Agricultural Use		5,160.6	5,002.9	3,488.3		6,542.1	5,697.9	4,664.1		6,695.3	5,785.2	4,985.4	PSA/DAU
38	Wetlands Use		411.4	237.1	104.4		441.6	275.1	148.1		411.7	269.4	135.1	PSA/DAU
39a	Urban Residential Use - Single Family - Interior		88.0				103.1				108.4			PSA/DAU
b	Urban Residential Use - Single Family - Exterior		160.6				191.2				203.9			PSA/DAU
c	Urban Residential Use - Multi-family - Interior		92.7				89.9				93.8			PSA/DAU
d	Urban Residential Use - Multi-family - Exterior		43.8				44.9				46.1			PSA/DAU
40	Urban Commercial Use		38.7				38.0				40.2			PSA/DAU
41	Urban Industrial Use		34.1				36.1				36.8			PSA/DAU
42	Urban Large Landscape		33.7				37.2				39.5			PSA/DAU
43	Urban Energy Production		-				-				-			PSA/DAU
44	Instream Flow		1,528.9	-	-		2,098.5	-	-		1,424.4	-	-	PSA/DAU
45	Required Delta Outflow		-	-	-		-	-	-		-	-	-	PSA/DAU
46	Wild & Scenic Rivers Use		3,661.1	-	-		2,093.8	-	-		1,091.0	-	-	PSA/DAU
47a	Evapotranspiration of Applied Water - Ag				3,409.7				4,405.8				4,627.6	PSA/DAU
b	Evapotranspiration of Applied Water - Managed Wetlands				104.4				148.1				135.1	PSA/DAU
c	Evapotranspiration of Applied Water - Urban				187.6				211.2				219.9	PSA/DAU
48	Evaporation and Evapotranspiration from Urban Wastewater				N/A				N/A				N/A	REGION
49	Return Flows Evaporation and Evapotranspiration - Ag				74.4				11.6				14.3	PSA/DAU
50	Urban Waste Water Produced	76.4				82.9				92.9				REGION
51a	Conveyance Evaporation and Evapotranspiration - Urban				15.1				16.0				15.7	PSA/DAU
b	Conveyance Evaporation and Evapotranspiration - Ag				211.9				252.6				248.1	PSA/DAU
c	Conveyance Evaporation and Evapotranspiration - Managed Wetlands				-				-				-	PSA/DAU
d	Conveyance Loss to Mexico				-				-				-	PSA/DAU
52a	Return Flows to Salt Sink - Ag				37.2				282.5				380.6	PSA/DAU
b	Return Flows to Salt Sink - Urban				109.2				119.3				132.2	PSA/DAU
c	Return Flows to Salt Sink - Wetlands				-				-				-	PSA/DAU
53	Remaining Natural Runoff - Flows to Salt Sink				-				-				-	REGION
54a	Outflow to Nevada													REGION
b	Outflow to Oregon													REGION
c	Outflow to Mexico													REGION
55	Regional Imports	5,191.8				5,287.6				3,890.3				REGION
56	Regional Exports	4,013.3				5,848.3				4,073.1				REGION
59	Groundwater Net Change in Storage	-443.1				-97.2				-1,332.3				REGION
60	Surface Water Net Change in Storage	2,179.9				67.4				-1,435.2				REGION
61	Surface Water Total Available Storage	11,372.3				11,477.1				11,477.1				REGION

Colored spaces are where data belongs. N/A - Data Not Available "-" - Data Not Applicable "0" - Null value

Table 7-3
San Joaquin River Hydrologic Region Water Use and Distribution of Dedicated Supplied

	1998			2000			2001		
	Applied Water Use	Net Water Use	Depletion	Applied Water Use	Net Water Use	Depletion	Applied Water Use	Net Water Use	Depletion
WATER USE									
Urban									
Large Landscape	33.7			37.2			39.5		
Commercial	38.7			38.0			40.2		
Industrial	34.1			36.1			36.8		
Energy Production	0.0			0.0			0.0		
Residential - Interior	180.7			193.0			202.2		
Residential - Exterior	204.4			236.1			250.0		
Evapotranspiration of Applied Water		187.6	187.6		211.2	211.2		219.9	219.9
Irrecoverable Losses		0.0	0.0		0.0	0.0		0.0	0.0
Outflow		100.0	100.0		109.9	109.9		122.8	122.8
Conveyance Losses - Applied Water	24.3			25.4			25.1		
Conveyance Losses - Evaporation		15.1	15.1		16.0	16.0		15.7	15.7
Conveyance Losses - Irrecoverable Losses		0.0	0.0		0.0	0.0		0.0	0.0
Conveyance Losses - Outflow		9.2	9.2		9.4	9.4		9.4	9.4
GW Recharge Applied Water	0.0			0.0			0.0		
GW Recharge Evap + Evapotranspiration		0.0	0.0		0.0	0.0		0.0	0.0
Total Urban Use	**515.9**	**311.9**	**311.9**	**565.8**	**346.5**	**346.5**	**593.8**	**367.8**	**367.8**
Agriculture									
On-Farm Applied Water	4,905.1			6,185.5			6,523.6		
Evapotranspiration of Applied Water		3,409.7	3,409.7		4,405.8	4,405.8		4,627.6	4,627.6
Irrecoverable Losses		74.4	74.4		11.6	11.6		14.3	14.3
Outflow		1,263.2	4.2		923.8	246.7		971.7	343.5
Conveyance Losses - Applied Water	399.9			472.3			457.8		
Conveyance Losses - Evaporation		211.9	211.9		252.6	252.6		248.1	248.1
Conveyance Losses - Irrecoverable Losses		0.0	0.0		0.0	0.0		0.0	0.0
Conveyance Losses - Outflow		33.0	33.0		35.8	35.8		37.1	37.1
GW Recharge Applied Water	255.5			356.6			171.7		
GW Recharge Evap + Evapotranspiration		0.0	0.0		0.0	0.0		0.0	0.0
Total Agricultural Use	**5,560.5**	**4,992.2**	**3,733.2**	**7,014.4**	**5,629.6**	**4,952.5**	**7,153.1**	**5,898.8**	**5,270.6**
Environmental									
Instream									
Applied Water	1,528.9			2,098.5			1,424.4		
Outflow		0.0	0.0		0.0	0.0		0.0	0.0
Wild & Scenic									
Applied Water	3,661.1			2,093.8			1,091.0		
Outflow		0.0	0.0		0.0	0.0		0.0	0.0
Required Delta Outflow									
Applied Water	0.0			0.0			0.0		
Outflow		0.0	0.0		0.0	0.0		0.0	0.0
Managed Wetlands									
Habitat Applied Water	411.4			441.6			411.7		
Evapotranspiration of Applied Water		104.4	104.4		148.1	148.1		135.1	135.1
Irrecoverable Losses		0.0	0.0		0.0	0.0		0.0	0.0
Outflow		132.7	0.1		126.7	0.0		134.2	0.0
Conveyance Losses - Applied Water	0.0			0.0			0.0		
Conveyance Losses - Evaporation		0.0	0.0		0.0	0.0		0.0	0.0
Conveyance Losses - Irrecoverable Losses		0.0	0.0		0.0	0.0		0.0	0.0
Conveyance Losses - Outflow		0.0	0.0		0.0	0.0		0.0	0.0
Total Managed Wetlands Use	411.4	237.1	104.5	441.6	274.8	148.1	411.7	269.3	135.1
Total Environmental Use	**5,601.4**	**237.1**	**104.5**	**4,633.9**	**274.8**	**148.1**	**2,927.1**	**269.3**	**135.1**
TOTAL USE AND LOSSES	**11,677.8**	**5,541.2**	**4,149.6**	**12,214.1**	**6,250.9**	**5,447.1**	**10,674.0**	**6,535.9**	**5,773.5**
DEDICATED WATER SUPPLIES									
Surface Water									
Local Deliveries	3,264.7	3,264.7	2,304.0	3,455.4	3,455.4	2,937.0	3,381.8	3,381.8	2,885.5
Local Imported Deliveries	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Colorado River Deliveries	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CVP Base and Project Deliveries	1,396.7	1,396.7	985.7	1,834.4	1,834.4	1,559.2	1,713.4	1,713.4	1,462.0
Other Federal Deliveries	63.4	63.4	44.7	63.2	63.2	53.7	96.4	96.4	82.3
SWP Deliveries	4.3	4.3	3.0	4.7	4.7	4.0	3.5	3.5	3.0
Required Environmental Instream Flow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Groundwater									
Net Withdrawal	810.2	810.2	810.2	891.3	891.3	891.3	1,338.9	1,338.9	1,338.9
Artificial Recharge	255.5			356.6			171.7		
Deep Percolation	684.5			1,407.7			1,444.3		
Reuse/Recycle									
Reuse Surface Water	5,196.6			4,198.9			2,522.1		
Recycled Water	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9
TOTAL SUPPLIES	**11,677.8**	**5,541.2**	**4,149.6**	**12,214.1**	**6,250.9**	**5,447.1**	**10,674.0**	**6,535.9**	**5,773.5**
Balance = Use - Supplies	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*

Figure 7-2
San Joaquin River Hydrologic Region 1998 Flow Diagram

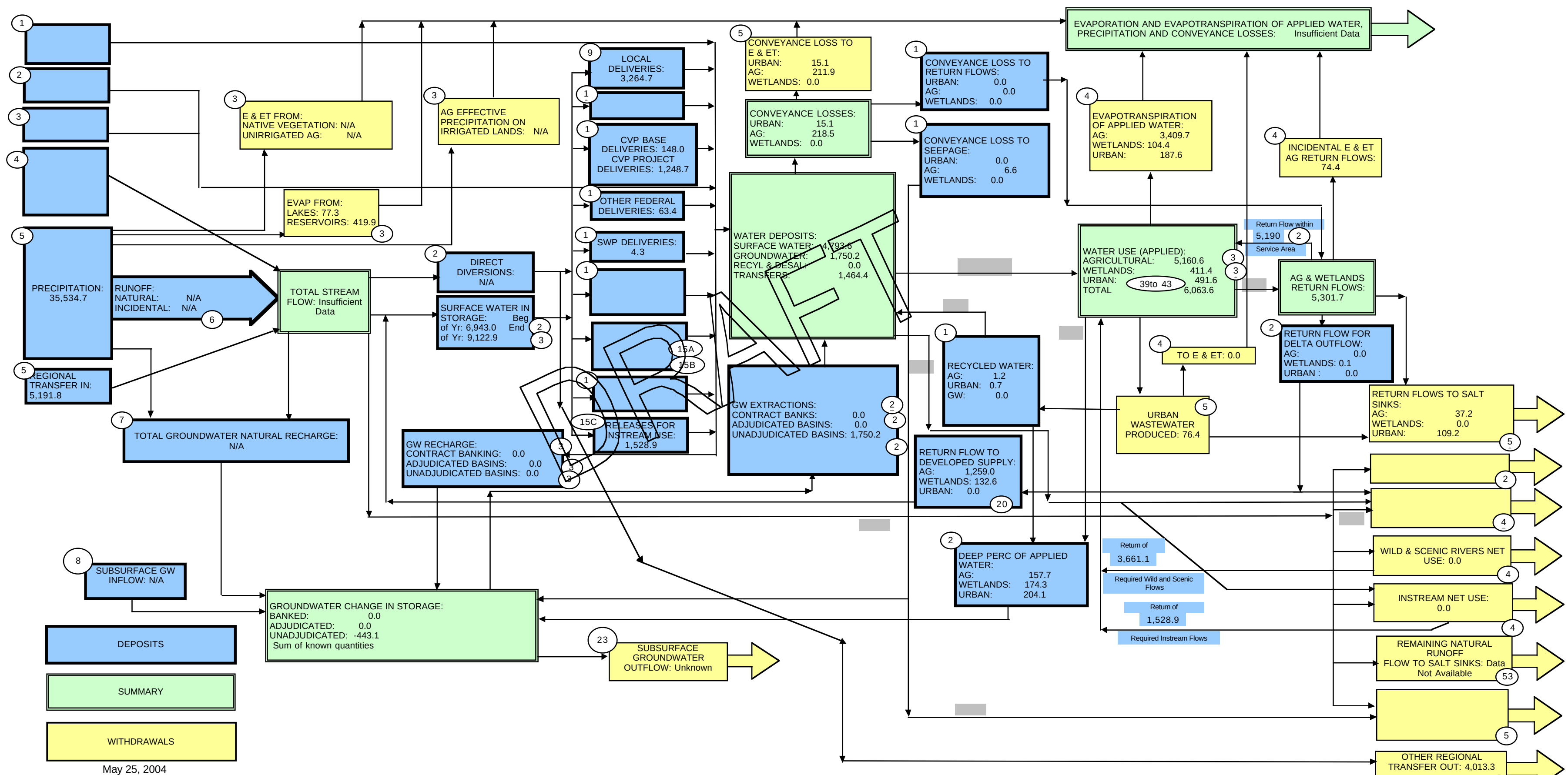


Figure 7-3
San Joaquin River Hydrologic Region 2000 Flow Diagram

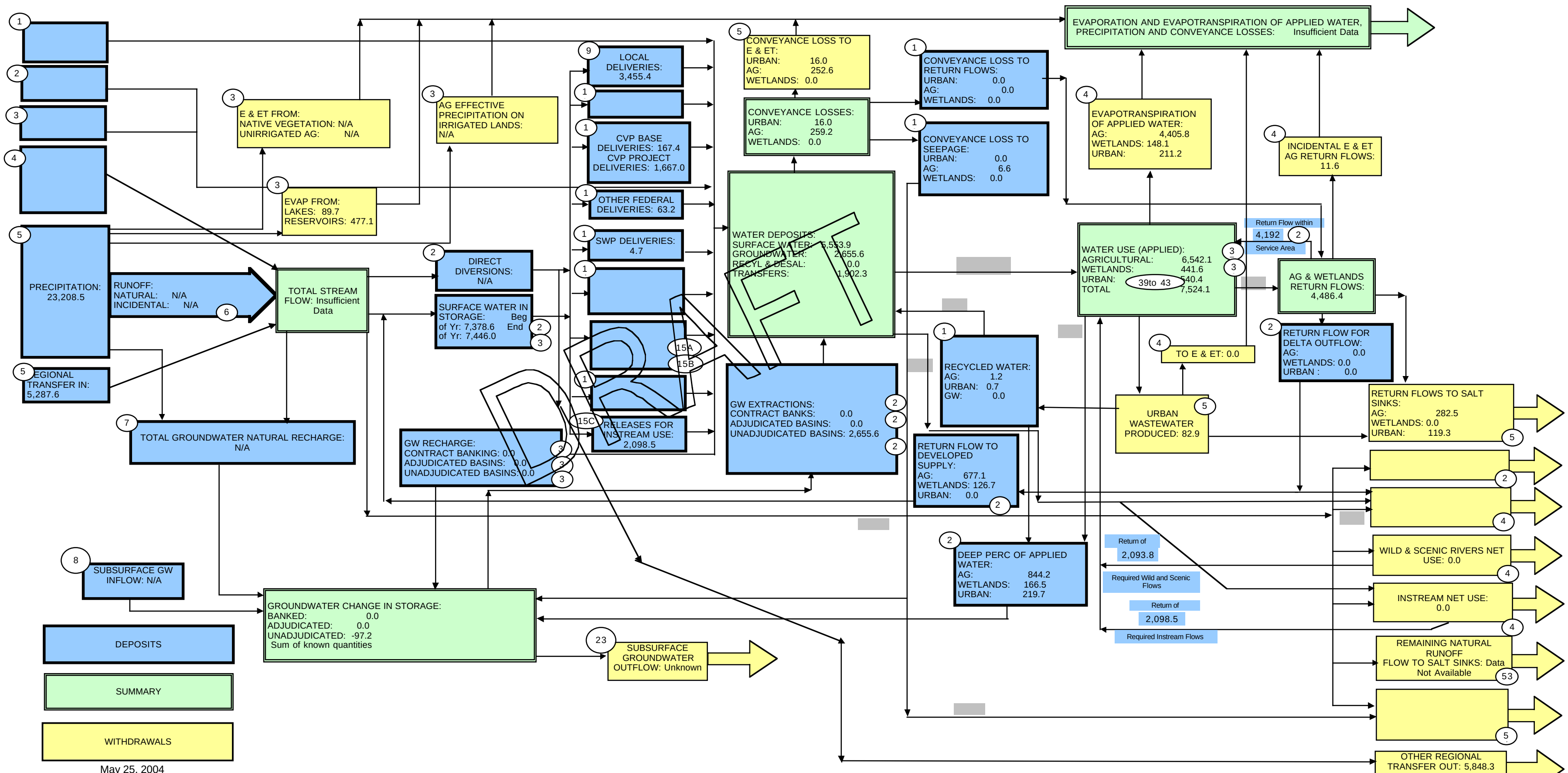


Figure 7-4
San Joaquin River Hydrologic Region 2001 Flow Diagram